PEBBLE BED REACTOR

SOLVING THE US ENERGY CRISIS

FRIDAY, APRIL 13, 2007

Nuclear powered cars are emissions free

 or  or 

Some ways to generate electricity for electric cars

Electric cars are emissions free, unless the electric power they use comes from coal power plants. Electric cars are becoming available, and more are planned.

ABOUT ME

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Retired from career in information systems, consulting, and software. Taught mathematics and computer science at Dartmouth College. PhD Physics Brown University, AB Mathematics Dartmouth College.

VIEW MY COMPLETE PROFILE

BLOG ARCHIVE

2010 Chevrolet Volt Electric Vehicle

Chevrolet will produce the Volt EV in the 2010-2012 time frame. It is powered by electricity from batteries that will allow the car to travel 40 miles on a single overnight charge. It also has a range extending internal combustion engine designed to run on gasoline, E85, or biodiesel fuels. The engine will give the drivers the confidence to venture out in a electric car, knowing they can drive even if the batteries run out. The turbo-charged three-cylinder engine provides 71 hp, and the electric motor can provide 161 hp. If you commute only 40 miles a day you can save 500 gallons of gasoline a year, saving $1200 after netting out the cost of electricity against $3 gasoline.

2008 Tesla Roadster Electric Car

This sports car can do 0-60 in about 4 seconds. Tesla Motors estimates

ENERGY LINKS

- Pebble Bed Reactor [presentations]
- MIT Pebble Bed Reactor
- US Dept of Energy Information
- Atomic Insights
- ClimateCrisis.org
- Nuclear Is Our Future
- Nuclear Energy Institute
- Nuclear Oil
- Idaho Samizdat: Nuke Notes
- Eskom Pebble Bed Modular Reactor

250 miles per charge, at a cost for electricity of about 1 cent per mile. Costing $92,000 it will not attract enough consumers to solve the US energy crisis, but it will be fun to drive.

2007 Toyota Prius plug-in hybrid shown to Bush

Consumers can today buy aftermarket conversion kits and batteries to allow cars such as the Toyota Prius to travel 20 miles on electric power alone. California is leading the nation in promoting plug-in hybrid vehicles.

Buying Nuclear Power for Cars

Originally conceived to lower energy costs through competition, electric deregulation has allowed consumers the choice of energy suppliers, and many choose "green" sources like wind power, or cow power (methane generated). Consumers pay a premium of about $0.04 per kilowatt-hour.

"Inconvenient Truth" Al Gore was criticized for the high energy consumption at his residence mansion, but his retort was that all his energy was purchased from "green" sources, so that he was not contributing to global warming. Providing a nuclear power purchasing option can similarly benefit the nuclear power industry, particularly if some electric vehicle fleets could be promoted as using clean, safe nuclear power.

I'd like to drive a car with a "Nuclear Powered" sign. Consumers today can not choose nuclear power. Nuclear power plant operators should file the necessary tariffs and enter into contracts with distribution utilities so

that a consumer could indeed buy nuclear power for recharging his vehicle.

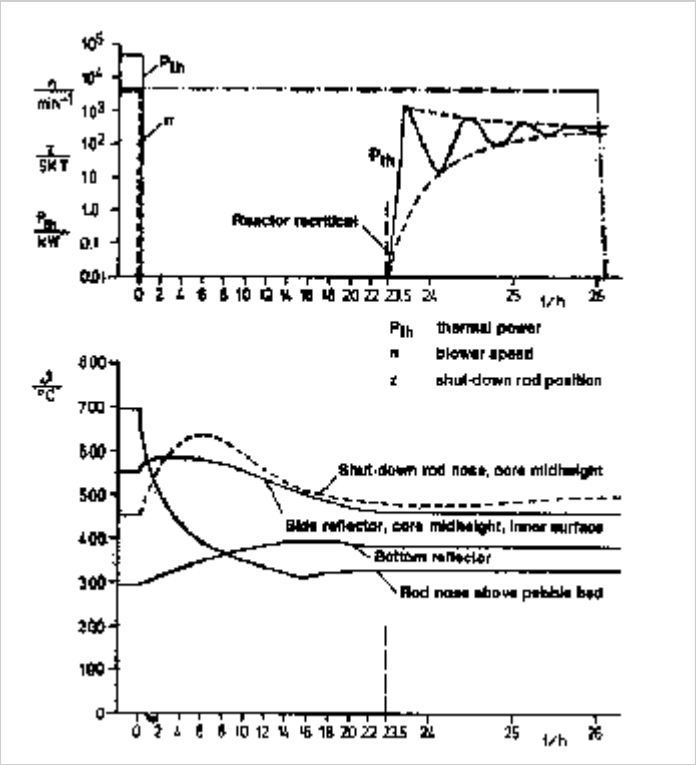
Melt-down-proof pebble bed reactors may be the power source for the future US automobile fleet.

POSTED BY ROBERT HARGRAVES AT 1:00 PM 2 COMMENTS LINKS TO THIS POST

LABELS: AUTOMOBILE, CAR, DEREGULATION, NUCLEAR POWER, PLUT-IN HYBRID, TESLA, VOLT

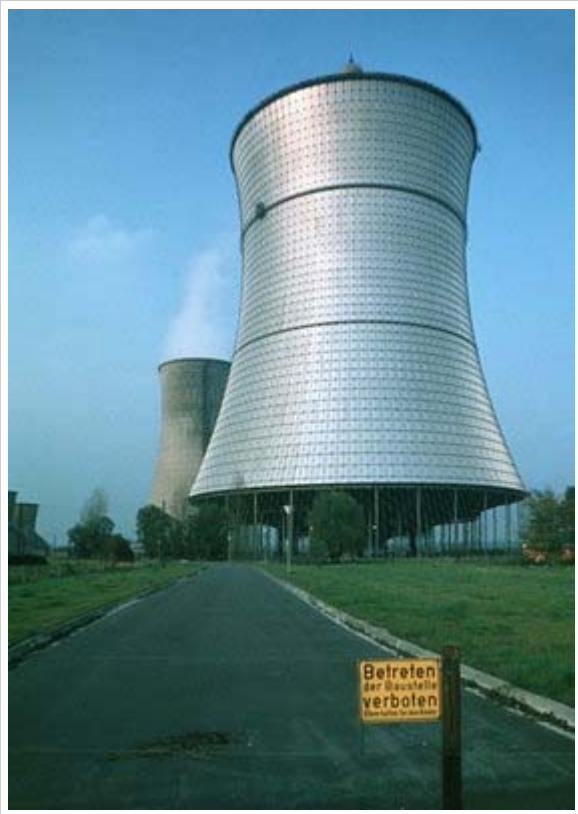
SATURDAY, APRIL 7, 2007

Germany built the first pebble bed reactor



Demonstration of inherently safe AVR shutdown

The pebble bed reactor is an intrinsically safe because the chain reaction diminishes as the fuel temperature rises. This has been demonstrated. The experimental Arbeitsgemeinschaft Versuchsreaktor (AVR) was built in Germany in 1960. Dr. Rudolf Schulten was the originator of the pebble bed reactor design. The experimental AVR at the Julich Research Center operated at 46 megawatt thermal power, about 13 negawatt electric. The safety test was performed in 1970 by stopping the cooling and preventing the control rods from activating. The temperature rose, Doppler broadening absorbed neutrons in U238, the chain reaction slowed, temperatures fell, and the unit stabilized at 300 kilowatts.



HTR-300 Cooling Tower

Germany also built a second pebble bed reactor, the THTR-300, which generated 300 megawatts when it achieved full power operation in 1989. THTR stands for Thorium High Temperature Reactor; it uses thorium to enrich the uranium fuel. Thorium is fertile in that it is not itself very radioactive but can be transformed into uranium fuel. The Th232 absorbs a neutron from the chain reaction of U235 decay, and then the Th233 decays into U233, which is a fissile element that participates in the chain reaction. Thorium is three times as plentiful as uranium in the earth's crust.

In 1986 an operator error caused some of the pebbles to be fractured and the helium gas lock to be jammed. An unknown amount of radioactive materials were released. The THTR-300 was shut down in 1989 following public concerns arising from the Chernobyl accident. Since then Germany has decided to shut down all its nuclear power plants.

POSTED BY ROBERT HARGRAVES AT 6:00 PM 0 COMMENTS LINKS TO THIS POST

LABELS: AVR, GERMANY, PEBBLE BED REACTOR, THORIUM, URANIUM

FRIDAY, MARCH 30, 2007

China has built a pebble bed reactor

HTR-10 at China's Tsinghua University

China's Tsinghua University has built a 10 MW research pebble bed reactor, achieving criticality in 2000. HTR-10 stands for High Temperature gas-cooled Reactor of 10 Megawatts heat output. It is cooled by helium gas. The helium gas today powers a steam generator. Currently the faculty and students are designing a power conversion unit to be driven directly by the hot helium. This unit will incorporate helium compressors and turbines with active magnetic bearings and a compact heat exchanger.

Tsinghua University and MIT collaborate on the development of this pebble bed reactor.

Australia exports uranium to China. The Australian Broadcasting Company recently interviewed Professor Zhang Zuoyi about the HTR-10 pebble bed reactor in China. During the visit the reactor helium cooling system was purposefully shut down to demonstrate the intrinsic, passive safety of the pebble bed reactor. You can see this on the video available on the ABC web site.

Demonstration plant for 19 pebble bed reactors

China has ambitious plans for pebble bed reactor nuclear power. According to MIT Professor Andrew Kadak China will build a 190 megawatt demonstration reactor power plant at Rongcheng. If successful, a total of 19 pebble bed reactors generating 3,600 megawatts will be constructed at that site.

China is not just waiting for pebble bed reactor nuclear power. China already operates 10 nuclear power reactors, with 7 under construction. Additionally China just signed a $6-7 billion contract with Westinghouse to build four AP-1000 advanced pressure water reactors generating 1,000 megawatts each. [This works out to $1,360 per kilowatt capital cost, below the design goal of the US NGNP project.] Westinghouse is a Pittsburgh company owned by Toshiba.

Shortly thereafter, China signed an agreement with France's Areva for two more nuclear power plants.

POSTED BY ROBERT HARGRAVES AT 5:31 PM 2 COMMENTS LINKS TO THIS POST

LABELS: CHINA, HELIUM, KADAK, MIT, PEBBLE BED REACTOR, TSINGHUA, TURBINE

SUNDAY, MARCH 25, 2007

South Africa is planning a Pebble Bed Reactor

PBMR vessel, turbines, and generator

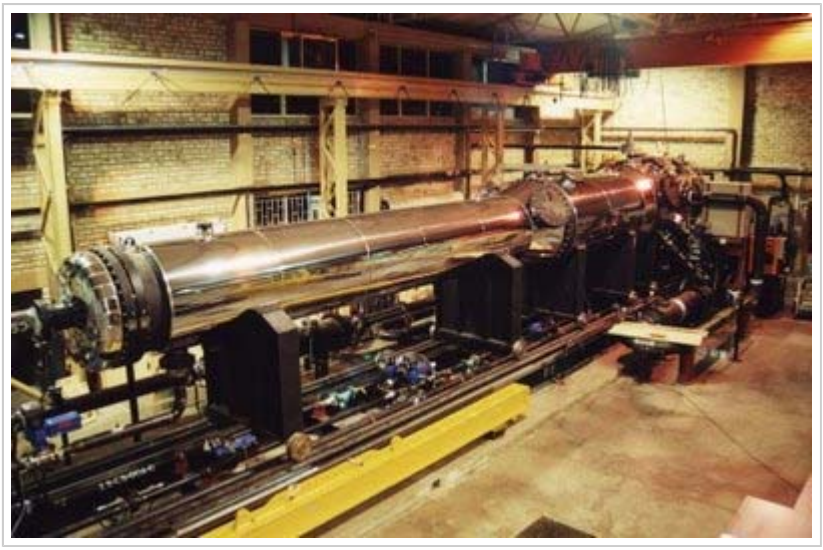
The Pebble Bed Modular Reactor (PBMR) is the terminology for South Africa's specific pebble bed reactor project and company. Pebble Bed Modular Reactor (Pty) Ltd has designed and is building a single module demonstration pebble bed reactor with a capacity of 165 MW. Assuming regulatory approvals, the demonstration plant will begin construction in 2008 with the first fuel load scheduled for 2012. If successful, South Africa intends to produce PBMR units for internal use and for export to Africa and the rest of the world. South Africa is planning to use 20 to 30 165 MW units to meet its own power needs.

The PBMR would be useful in many emerging nations than cannot afford billion dollar 1,000 MW power plants common in the US. Because the PBMR is refueled while in operation without being shut down, it can be a single, reliable electric power source in isolated regions. Exporting PBMRs could be a significant income source for South Africa, which is contemplating exporting 10 units per year, perhaps selling in the $150-200 million range. PBMR Pty Ltd has already taken preliminary steps with the US Nuclear Regulatory Commission to license the PBMR for the US market.

Eskom, the South African utility company, began investigating pebble bed technology in 1993, obtaining a license for the technology first developed in Germany in 1966. Eskom was joined by other investors in 2000, including the Industrial Development Corporation of South Africa, British Nuclear Fuels (BNFL), and the US utility Exelon. Since then Exelon has dropped out and the BNFL role has been taken over by Westinghouse, which BNFL sold to Toshiba.

Progress is being made

Mitsubishi Heavy Industries has been awarded the contract for the basic design of the core barrel assembly of the reactor vessel. According to PBMR Ltd, Mitsubishi will be the integrator and single point supplier for the complete system.



Prototype helium turbine built in Potchefstroom

The gas turbine test rig was built by the engineering department of the University of Potchefstroom near Johannesburg. The main pressure vessel of the test rig is 17.5 meters long and weighs 12 tons. The test rig represents the first closed-cycle, multi-shaft gas turbine in the world.

Uranium fuel kernels production

Pelindaba Labs has created a process for producing the small kernels of UO2 that are the fuel for the PBMR.

Earthlife Africa opposes the PBMR and in 2005 persuaded the court to set aside the positive Record of Decision on the environmental impact study. In January 2007 the Department of Environmental Affairs permitted the project to go ahead with the pilot fuel plant at Pelindaba.

Helium test facility

The project has constructed a helium test facility at Pelindaba near Pretoria. It is to test the complete, high temperature, high-pressure helium cycle. The test facility will also simulate fuel-handling, reactivity control, and shut-down.

Summary

The design and planning of the PBMR demonstration reactor and pilot fuel plant are well underway. Funds have been made available. The fuel plant environmental impact statement has been accepted, but the EIA for the demonstration reactor and the nuclear licensing still have to be finalized. Fuel fabrication, helium testing, and turbine manufacturing are underway. Plans are that the demonstration reactor will start construction in 2008 and be operating in 2012.

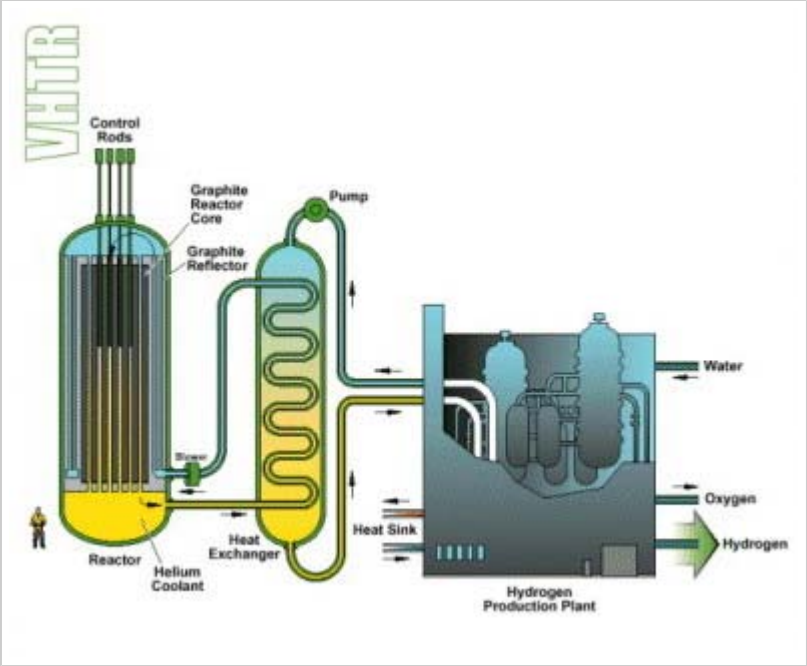
POSTED BY ROBERT HARGRAVES AT 9:00 AM 1 COMMENTS LINKS TO THIS

POST

LABELS: HELIUM, PEBBLE BED REACTOR, SOUTH AFRICA, TURBINE, URANIUM

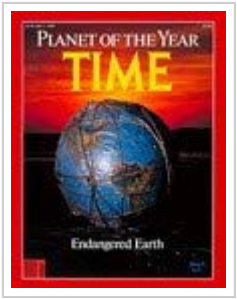
SATURDAY, MARCH 17, 2007

Idaho National Laboratory would build the first US PBR



INL Very High Temperature Reactor

In the hospital waiting room last week I was astonished to find the January 2, 1989, copy of Time magazine. Time described an "inherently safe...heat-resistant ceramic spheres...cooled by inert helium gas" reactor to be built by the US government in Idaho Falls. This pebble bed reactor project has been awaiting funding for at least 18 years.



The 1989 Time magazine also contained an article, *Global Warming Feeling the Heat*, quoting remarks by James Hansen, head of NASA's Goddard Institute for Space Studies, the first high level US scientist to emphasize the effect of society's CO2 emissions on climate.

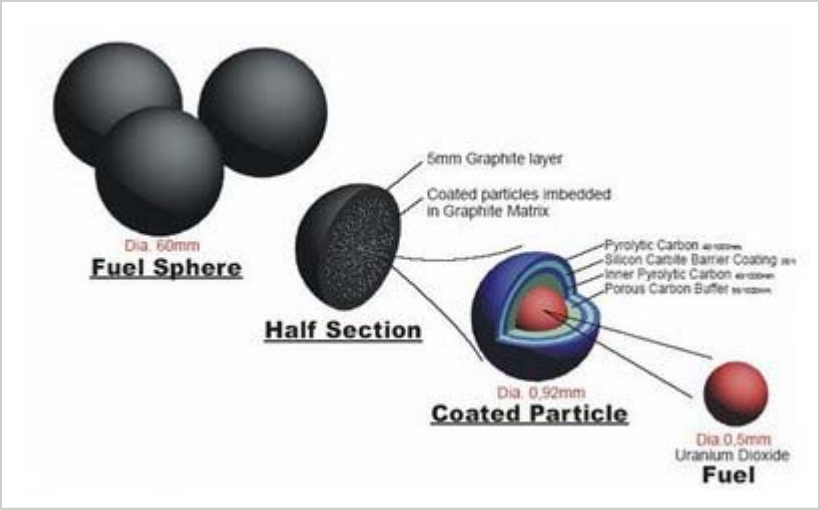
It's taking us more than 18 years to face up to the facts that

- our CO2 emissions contribute to global warming, and
- nuclear power can reduce CO2 emissions.

Idaho National Laboratory

Idaho National Laboratory (INL) is situated on 890 square miles of the southeastern Idaho desert. Established in 1949, it has been the principal locus of research and testing of nuclear power systems in the US. The first nuclear reactor to produce electric power operated there in 1951. INL has designed and constructed 52 nuclear reactors, including breeder reactors, marine propulsion reactors, boiling water reactors, and a gas cooled reactor. INL employs approximately 8,000 scientists, engineers, technicians, and management personnel.

INL currently operates two nuclear reactors, including the Advanced Test Reactor, used to test materials for building future reactors. Materials can swell or become brittle after long periods of radiation. This reactor operates at such a high neutron flux that the effect of years of exposure in commercial reactors can be duplicated in weeks or months.



Pebble Bed Reactor Fuel

Together with Oak Ridge National Laboratory and BWXT, INL has been fabricating ceramic-encapsulated uranium fuel for the pebble bed reactor in 2006. Sample fuel cylindrical pellets were placed in the Advanced Test Reactor to test the materials in the high neutron flux. These fuel pellets will be removed and examined in 2008, having been exposed to the equivalent of many years of exposure within a pebble bed reactor. INL plans to test the complete fuel spheres as well.

US Energy Policy Act of 2005

The US Energy Policy Act of 2005 directs the establishment of a Next Generation Nuclear Plant to produce electricity, hydrogen, or both. INL is specified as the site of the nuclear reactor and associated plant. The Act authorizes $1.25 billion for the project, however the Congress has not yet appropriated this money.

Currently there are six candidate technologies under study at INL.

- Gas Cooled Fast Reactor (GRF)
- Very High Temperature Reactor (VHTR)
- Supercritical Water Cooled Reactor (SCWR)
- Sodium Cooled Fast Reactor (SFR)
- Lead Cooled Fast Reactor (LCR)
- MSR Molten Salt Reactor (MSR)

Nuclear Hydrogen Production

Hydrogen is a feedstock for the production of hydrocarbon vehicle fuels, such as H3COH (methanol) and H3COCH3 (dimethyl ether). Efficient production of hydrogen is possible with the high 900-950 C temperature of a very high temperature gas reactor, such as the pebble bed reactor. Two candidate hydrogen production technologies are the sulfur-iodine cycle and high-temperature electrolysis under study at INL.

The PBR is a prime candidate for the Generation IV prototype to be built at Idaho National Laboratories.

POSTED BY ROBERT HARGRAVES AT 10:27 AM 1 COMMENTS LINKS TO THIS POST

LABELS: GLOBAL WARMING, HELIUM, IDAHO NATIONAL LABORATORIES, INL, PEBBLE BED REACTOR, PYROLYTIC CARBON

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